CERTIFICATE OF VERIFICATION

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state that the attached documents are a true and complete translation to the best of my knowledge of Japanese Patent Application No. 297087/1998.

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Semiconductor Production Apparatus

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[Title of the Invention]

Semiconductor Production Apparatus

[Claims]

[Claim 1] A semiconductor production apparatus for heat-treating a semiconductor wafer which is located in a process chamber, said process chamber having an inlet and an outlet for a process gas and a heating source disposed therein, said semiconductor production apparatus comprising:

a susceptor disposed within said process chamber, said susceptor having an upper surface for mounting said semiconductor wafer thereon; and

a susceptor supporting shaft for supporting said susceptor from thereunder,

wherein said susceptor supporting shaft has a main shaft positioned substantially coaxial with a center of said susceptor, and at least three arms radially extending from an upper end of said main shaft, each of said arms having a distal end provided with a protrusion directed toward said susceptor, and wherein a peripheral portion of a lower surface of said susceptor is formed with recesses, each of said recesses having an inside diameter substantially identical to an outside diameter of said protrusion, adapted to engage said protrusion.

[Claim 2] A semiconductor production apparatus according to claim 1, wherein said recess has an elongated form extending in a radial direction of said susceptor.

[Claim 3] A semiconductor production apparatus according to claim 1 or 2, wherein said recess has an elongated form extending in a radial direction of said susceptor, and wherein said protrusion is engaged in said elongated recess on the outermost peripheral side thereof.

[Claim 4] A semiconductor production apparatus according to any one of claims 1 to 3, wherein said susceptor comprises carbon graphite, and said susceptor supporting shaft comprises silica glass.

[Claim 5] A semiconductor production apparatus according to any one of claims 1 to 3, wherein said susceptor comprises carbon graphite having a surface coated with silicon carbide, and said susceptor supporting shaft comprises silica glass.

[Claim 6] A semiconductor production apparatus according to claim 1, wherein said susceptor comprises silicon carbide, and said susceptor supporting shaft comprises silica glass.

[Detailed Description of the Invention]

[0001]

[Technical Field to which the Invention

Pertains]

The present invention relates to a semiconductor production apparatus such as epitaxial growth apparatus and rapid thermal treatment apparatus, and, in particular, to improvements in a susceptor as a wafer support and a shaft for supporting the susceptor.

[0002]

[Prior Art]

Fig. 6 is a sectional view schematically showing a major-part of an epitaxial growth apparatus 10 which is one of conventional semiconductor production apparatus. In Fig. 6, the epitaxial growth apparatus 10 is of a single wafer processing type, which processes semiconductor wafers or silicon wafers W one by one, and comprises a process chamber 12 constituted by silica glass, and a susceptor 14 disposed within the process chamber 12 for supporting a wafer W. The susceptor 14 is supported by a susceptor supporting shaft 15. A side portion of the process chamber 12 is formed with an inlet 16 for a process gas, whereas an outlet 18 is formed at a position opposite from the inlet 16. A plurality of halogen lamps 20 are radially disposed in each of areas above and below the process chamber 12.

[0003]

Fig. 7 is a schematic perspective view showing

the susceptor and susceptor supporting shaft of the conventional wafer support. Fig. 8 is a bottom plan view of the susceptor 14. As shown in these figures, the susceptor supporting shaft 15 is constructed by a main shaft 15a, and three arms 15b arranged at equally spaced intervals in the circumferential direction so as to radially extend from the upper end of the main shaft 15a. The distal ends of the main shaft 15a and the arms 15b are provided with circular-rod-like protrusions 15c and 15d for supporting the susceptor 14, respectively. Also, the lower surface of the susceptor 14 is formed with depressions or recesses 14a, 14b, 14c located at the positions corresponding to the protrusions 15c and 15d, respectively. Here, since the susceptor 14 is positioned by the recess 14a formed at the center of the susceptor 14 and the protrusion 15c, the inside diameter of the recess 14a and the outside diameter of the protrusion 15c are substantially identical to each other. The recess 14b is shaped into an elongated hole for preventing the susceptor 14 from circumferentially moving about the protrusion 15c. The recesses 14c are countersunk holes for simply supporting the susceptor 14.

[0004]

In the conventional epitaxial growth apparatus 10, which is configured as in the foregoing, a silicon

wafer W is initially mounted on the susceptor 14, and then the halogen lamps 20 are lit, so as to heat the silicon wafer W. At the same time, trichlorosilane ($SiHCl_3$) gas, dichlorosilane (SiH_2Cl_2) gas, or the like, for example, is introduced as a process gas from the inlet 16 while being let out from the outlet 18. Then, the process gas flows in the state of a laminar flow along the surface of the silicon wafer W heated to a predetermined temperature, whereby a single crystal of silicon epitaxially grows on the silicon wafer W.

[0005]

[Problem to be Solved by the Invention]

Fig. 5 is a graph showing, in the case where a 200-mm silicon wafer W is used for forming a silicon film upon epitaxial growth by way of example, the relationship between the distance from the center point of silicon wafer W and the thickness of silicon film. Curve B in Fig. 5 indicates the results obtained in a wafer support of a conventional type. From this graph, it is seen that the film thickness abruptly decreases in the vicinity of the center of wafer W in the conventional wafer support, whereby an epitaxially grown silicon film having a substantially uniform thickness cannot be obtained. Thus, the inventors have carried out various studies in order to seek the cause of the above-mentioned problem and,

as a result, have reached a conclusion that the protrusion 15c located under the center of susceptor 14 inhibits the radiant heat from the halogen lamps 20 under the process chamber.

[0006]

The present invention takes the above information into consideration and aims to provide a semiconductor production apparatus including an improved susceptor as a wafer support and an improved susceptor supporting shaft, which can yield an epitaxially grown silicon film having a substantially uniform thickness, without using additional apparatus.

[0007]

[Means for Solving the Problem]

The present invention claimed in Claim 1 is directed to a semiconductor production apparatus for heat-treating a semiconductor wafer which is located in a process chamber, the process chamber having an inlet and an outlet for a process gas and a heating source disposed therein, the semiconductor production apparatus being characterized by comprising: a susceptor disposed within the process chamber, the susceptor having an upper surface for mounting the semiconductor wafer thereon; and a susceptor supporting shaft for supporting the

susceptor from thereunder, wherein the susceptor supporting shaft has a main shaft positioned substantially coaxial with a center of the susceptor, and at least three arms radially extending from an upper end of the main shaft, each arm having a distal end provided with a protrusion directed toward the susceptor, and wherein a peripheral portion of a lower surface of the susceptor is formed with recesses, each recess having an inside diameter substantially identical to an outside diameter of the protrusion, adapted to engage the protrusion.

[0008]

The present invention claimed in Claim 2 is characterized in that the recess has an elongated form extending in a radial direction of the susceptor.

[0009]

The present invention claimed in Claim 3 is characterized in that the recess has an elongated form extending in a radial direction of the susceptor, and that the protrusion is engaged in the elongated recess on the outermost peripheral side thereof.

[0010]

The present invention claimed in Claim 4 is characterized in that the susceptor comprises carbon graphite and the susceptor supporting shaft comprises silica glass.

[0011]

The present invention claimed in Claim 5 is characterized in that the susceptor comprises carbon graphite having a surface coated with silicon carbide and the susceptor supporting shaft comprises silica glass.

[0012]

The present invention claimed in Claim 6 is characterized in that the susceptor comprises silicon carbide and the susceptor supporting shaft comprises silica glass.

[0013]

According to the present invention, the susceptor is supported by only the arms which extend toward the peripheral portion of the susceptor, and no protrusion of the susceptor supporting shaft is disposed at the center of the lower surface of susceptor. Therefore, the center of the susceptor can be heated without inhibiting the radiant heat of a heating source located in the bottom portion of the process chamber. As a consequence, the whole of the susceptor and the semiconductor wafer is uniformly heated, and a film is grown obtained with a uniform thickness throughout the entire surface of the semiconductor wafer . Also, since the positioning is effected by at least three points by the recesses

formed at the peripheral portion in the lower surface of susceptor and the protrusions of arm ends of susceptor supporting shaft, it yields an effect that more accurate positioning can be carried out.

[0014]

[Embodiments of the Invention]

In the following, a preferred embodiment of the present invention will be explained in detail with reference to the attached drawings.

[0015]

Fig. 1 is a sectional view schematically showing a major-part of a semiconductor production apparatus, for example an epitaxial growth apparatus in accordance with an embodiment of the present invention. In the following description, like references characters designate like or corresponding parts throughout the several views. AS shown in Fig. 1, the epitaxial growth apparatus 10A is of a single wafer processing type, which processes semiconductor wafers or silicon wafers W one by one, and comprises a process chamber 12 constituted by silica glass, for example, and a susceptor 14A disposed within the process chamber 12 for supporting a wafer W. The susceptor 14A is supported by susceptor supporting shaft 15A. The susceptor 14A and the susceptor supporting shaft 15A constitute a wafer support. A

side portion of the process chamber 12 is formed with an inlet 16 for a process gas. Also, a side portion of the process chamber 12 is formed with an outlet 18 at a position opposite from the inlet 16. A plurality of halogen lamps 20 are radially disposed with an appropriate arrangement in each of areas above and below the process chamber 12.

[0016]

Fig. 2 is a schematic perspective view showing the wafer support comprising the susceptor and susceptor supporting shaft. Fig. 3 is a bottom plan view showing the susceptor 14A. AS shown in Figs. 1 to 3, the susceptor supporting shaft 15A has a main shaft 15B, and three arms 15C radially extending outward from an upper end of the main shaft 15B. The distal end of each arm 15C is integrally formed with a round-bar-shaped protrusion 15D for resting and supporting the susceptor 14A thereon. Recesses 14B are formed in the lower surface of the susceptor 14A at the positions where the upper ends of protrusions 15D abut, respectively. As shown in Fig. 4, the depth of the recess 14B is about half the thickness of the susceptor 14A.

[0017]

Since the positioning of the susceptor 14A is effected by the recesses 14B formed at the peripheral

portion of the lower surface of the susceptor 14A and the protrusions 15D, the inside diameter of the recess 14B and the outside diameter of the protrusion 15D are substantially identical to each other. Here, although the recess 14B and the protrusion 15D may be of circular cross-sectional form, it is desirable that the recess 15D is of an elongated shape extending in the radial direction of the susceptor 14A in order to absorb the difference in coefficient of thermal expansion between the susceptor 14A and the susceptor supporting shaft 15A. For example, when the susceptor supporting shaft 15A is made of silica glass and the susceptor 14A is made of carbon graphite having a coefficient of thermal expansion greater than that of silica glass, it is desirable that the protrusion 15D is positioned on the outermost peripheral side of the associated recess 14B at ambient temperature. As a matter of course, the susceptor 14A may be made solely of other materials such as silicon carbide, or may be formed from carbon graphite having a surface coated with silicon carbide. With this arrangement, since the susceptor 14A is supported and positioned by the three protrusions 15D of the susceptor supporting shaft 15A, more accurate positioning can be obtained.

[0018]

The epitaxial growth apparatus 10 of the present invention is constructed as stated above. In operation, a silicon wafer W is initially mounted on the susceptor 14A. Thereafter, the halogen lamps 20 are lit to heat the silicon wafer W. At the same time, trichlorosilane ($SiHCl_3$) gas, dichlorosilane (SiH_2Cl_2) gas, or the like, for example, is introduced as a process gas from the inlet 16 while being let out from the outlet 18. Then, the process gas flows in the state of a laminar flow along the surface of the silicon wafer W heated to a predetermined temperature, whereby a single crystal of silicon epitaxially grows on the silicon wafer W.

[0019]

Fig. 5 is a graph showing, in the case where a 200-mm silicon wafer W is used for forming a silicon film upon epitaxial growth by way of example, the relationship between the distance from the center point of silicon wafer W and the thickness of silicon film. Curve A indicates the results of the present invention. As seen in this figure, no fluctuation in film thickness is observed even in the vicinity of the center of wafer W, whereby an epitaxially grown silicon film having a substantially uniform thickness can be obtained. It is presumed to be because of the fact that, since no protruded part exists under the

center of susceptor 14A, the film is grown in a state where the silicon wafer W is uniformly heated without inhibiting the radiant heat of the halogen lamps 20 from under the process chamber 12.

[0020]

Though the case where an epitaxial growth apparatus is used as a semiconductor production apparatus is explained in the above-mentioned embodiment, the present invention is not restricted thereby and is applicable to various semiconductor production apparatus such as rapid heat treatment annealing apparatus and thermal CVD apparatus. Also, though the case where the susceptor supporting shaft has three arms is explained in the above-mentioned embodiment, three or more arms can be used as well.

[0021]

[Effects of the Invention]

Since an improved wafer support of the present invention comprises a susceptor and a susceptor supporting shaft as explained in the foregoing, the center of susceptor mounting a semiconductor wafer can be heated without inhibiting the radiant heat of a heating source such as halogen lamp from under the process chamber. As a consequence, it yields an effect that an epitaxially grown silicon film having a uniform thickness is obtained. Also, since the

positioning is effected by at least three points by the recesses formed at the peripheral portion in the lower surface of susceptor and the protrusions of arm ends of susceptor supporting shaft, it yields an effect that more accurate positioning can be carried out.

[Brief Description of the Drawings]

[Fig. 1] is a sectional view schematically showing a semiconductor production apparatus in accordance with the present invention;

[Fig. 2] is a schematic perspective view showing a susceptor and a susceptor supporting shaft which constitute a wafer support;

[Fig. 3] is a bottom plan view showing the susceptor 14A;

[Fig. 4] is a sectional view taken along the line A-A of Fig. 3;

[Fig. 5] is a graph showing the relationship between the distance from the center of a silicon wafer W and the thickness of silicon film;

[Fig. 6] is a sectional view schematically showing a conventional semiconductor production apparatus;

[Fig. 7] is a schematic perspective view showing a susceptor and a susceptor supporting shaft which constitute a conventional wafer support; and

[Fig. 8] is a bottom plan view of the conventional

susceptor.

[Explanation of Reference Numerals]

10A・・・epitaxial growth apparatus, 12・・・process chamber, 14A・・・susceptor, 14B・・・recess, 15A・・・susceptor supporting shaft, 15B・・・main shaft, 15C・・・arm, 15D・・・protrusion, 16・・・inlet, 18・・・outlet, 20・・・halogen lamp.

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